IN THE U.S. PATENT OFFICE

Applicant : Kazuyoshi Koizumi et al.

Title : ROTARY DAMPER

Serial No. : 10/572,378

Filed : March 16, 2006

VERIFICATION OF TRANSLATION

Sir:

I, Kyoko NAKAMURA, residing at 2211 Whiteoaks Dr. Alexandria, VA 22306, declare that I am fluent in Japanese and English, and that herewith submitted English translations of Priority Documents No. 2003-324890 filed on September 17, 2003 and No. 2004-007951 filed on January 15, 2004 for the above-identified U. S. patent application are true and accurate literal translations.

Kyoko Nakamura

Date: April 8, 2009

JAPAN PATENT OFFICE

This is to certify that the annexed is a true copy of the following application as filed with this office.

Date of Application:	September 17, 2003
Application Number:	2003-324890
[ST. 10/C]:	[JP 2003-324890]

Applicant(s):	Nifco Inc.

June 8, 2004

Commissioner,

Japan Patent Office: Yasuo Imai (Sealed)

[Name of Document]	Patent Application
[Serial Number]	20030121
[Filing Date]	September 17, 2003
[Addressee]	Mr. Yasuo Imai Commissioner, the Patent Office
[International Patents Classification]	F16F 9/12
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[Reserve Note No.]	086277
[Amount to Be Paid]	21,000 Yen
[List of Submission]	
[Name]	Scope of Patent Claim 1
[Name]	Specification 1
[Name]	Drawing 1
[Name]	Statement of Abstract 1
[Comprehensive Power of Attorney's Number]	0101354

[Name of Document] Scope of Patent Claim

[Claim 1] A rotary damper comprising:

a housing;

a viscous fluid being housed inside the housing;

a rotor wherein a resistive portion which moves through said viscous fluid inside said housing is provided in an axial portion being housed inside said housing and whose one part projects from said housing; and

a sealing member preventing said viscous fluid from leaking between said axial portion and said housing, and multiple air retention portions are provided in said resistive portion in a circumferential direction, and an air movement passage connecting the air retention portions is provided.

[Claim 2] A rotary damper according to claim 1, wherein said air retention portion is formed by a through-bore, and said air movement passage is formed by a depressed groove.

[Claim 3] A rotary damper according to claim 1 or 2, wherein said multiple air retention portions are formed in a concentric circle, and said air movement passage includes a circumferential groove corresponding to said air retention portion and being provided in said housing.

[Claim 4] A rotary damper according to claim 1, wherein said multiple air retention portions are formed between the outer circumferential surface of said resistive portion and the inner circumferential surface of said housing in a circumferential direction.

[Name of Document] Specification

[Title of the Invention] ROTARY DAMPER

[Technical Field]

[0001]

The present invention relates to a rotary damper for damping the rotation of a driven gear which engages with, for example, a gear or rack.

[Background Art]

[0002]

The above-mentioned rotary damper is constituted of: a housing; viscous fluid being housed inside the housing; a rotor wherein a resistive portion moving through the viscous fluid inside the housing is provided in an axial portion which is housed inside the housing and whose one part projects from the housing; and a sealing member which prevents the viscous fluid from leaking between the axial portion of the rotor and the housing.

Incidentally, a driven gear is attached to the axial portion projecting from the housing.

[Patent Document 1] Japanese Patent Publication No. H04-34015

[Disclosure of Invention]

[Problems to Be Solved by the Invention]

[0003]

In the conventional rotary damper, the resistive portion has a roughly oval shape so that the air being mixed into the housing when the rotary damper is assembled is not allowed to be located between the resistive portion of the rotor which is a part of

torque occurrence and the bottom face or ceiling face of the housing.

However, since the rotor rotates bi-directionally, when the air being mixed into the housing climbs over the resistive portion and moves to the opposite side of the resistive portion, the air makes a noise.

The noise which occurs when the air being mixed into the housing climbs over the resistive portion is regarded as a plosive sound being caused by the following. When the air being mixed into the housing climbs over the resistive portion after the air being mixed into the housing is compressed by climbing over the resistive portion, the air being mixed into the housing is rapidly opened so that the plosive sound is made.

Incidentally, the higher the degree of viscosity the viscous fluid has, the easier the noise is made. Also, the narrower the distance between the rotor and housing is, the easier the noise is made.

[0004]

The present invention provides a rotary damper which prevents the noise being caused by the air being mixed into the housing even if the rotor rotates bi-directionally, by not excessively compressing the air being mixed into the housing during the assembly.

[Means to Solve the Problems]

[0005]

The present invention is the following invention.

(1) A rotary damper of the invention is constituted by: a housing; viscous fluid being housed inside the housing; a rotor

wherein a resistive portion moving through the viscous fluid inside the housing is provided in an axial portion being housed inside the housing and whose one part projects from the housing; and a sealing member which prevents the viscous fluid from leaking between the axial portion and the housing. In the rotary damper, multiple air retention portions are provided in the resistive portion in a circumferential direction and an air movement passage connecting the air retention portions is provided.

(2) In the rotary damper of the invention, the air retention portions are formed by through-bores, and the air movement passage is formed by a depressed groove.

(3) In the rotary damper of the invention, the multiple air retention portions are formed on a concentric circle, and the air movement passage includes a circumferential groove corresponding to the air retention portions and being provided in the housing.

(4) In the rotary damper of the invention, the multiple air retention portions are formed between the outer circumferential surface of the resistive portion and the inner circumferential surface of the housing in a circumferential direction.

[Effect of the Invention]

[0006]

According to the invention, the multiple air retention portions (through-bores) are provided in the resistive portion in a circumferential direction, and the air movement passage (depressed groove) connecting the air retention portions (through-bores) is provided, so that when the rotary damper is assembled, the air being mixed into the housing can be moved from one air retention portion (through-bore) to another air retention portion (though-

bore) in a state wherein the air being mixed into the housing is not excessively compressed.

Therefore, even if the rotor rotates bi-directionally, the noise being caused by the air being mixed into the housing can be prevented.

Moreover, the multiple air retention portions are formed on a concentric circle, and the air movement passage includes the circumferential groove being provided in the housing and corresponding to the air retention portions. Accordingly, when the rotary damper is assembled, the air being mixed into the housing can be moved from one air retention portion to the other air retention portion in a state of being additionally compressed, so that the noise being caused by the air being mixed into the housing can be additionally prevented.

Also, since the multiple air retention portions are formed between the outer circumferential surface of the resistive portion and the inner circumferential surface of the housing in a circumferential direction, when the rotary damper is assembled, the air being mixed into the housing can be moved from one air retention portion to the other air retention portion without being additionally compressed, so that the noise being caused by the air being mixed into the housing can be additionally prevented.

Also, since the multiple air retention portions are formed between the outer circumferential surface of the resistive portion and the inner circumferential surface of the housing in a circumferential direction, when the rotary damper is assembled, the air being mixed into the housing can be reliably located in the air retention portions.

[Preferred embodiment of the Invention]

[0007]

The present invention will be explained with reference to the attached figures in detail.

Fig. 1 is a cross-sectional view showing the first embodiment of a rotary damper of the present invention; Fig. 2 is a cross-sectional view of a rotor of the rotary damper in Fig. 1; Fig. 3 is a plan view of the rotor shown in Fig. 2; and Fig. 4 is a bottom plan view of the rotor shown in Fig. 2.

[0008]

In Fig. 1, the reference alphabet D represents the rotary damper including: a plastic case 11; a silicon oil 21 as viscous fluid being housed inside the case 11; a plastic rotor 31 wherein a resistive portion 36 moving through the silicon oil 21 inside the case 11 is provided in an axial portion 32 which is housed inside the case 11 and whose one part projects from the case 11 to the outside; and a through-bore 52 wherein the axial portion 32 of the rotor 31 penetrates. The rotary damper D is constituted by: a plastic cap 51 blocking an opening of the case 11; an O-ring 61 as a sealing member preventing the silicon oil 21 from leaking between the cap 51 and the axial portion 32 of the rotor 31; and a plastic driven gear 71 being attached to the axial portion 32 of the rotor 31 projecting from the cap 51.

Incidentally, the housing is constituted by the case 11 and the cap 51.

[0009]

The above-mentioned case 11 is constituted by: a case main body 12 wherein a cylindrical wall portion 14 circling the outer

edge of a bottom portion 13 whose planar shape is a circle is provided; a cylindrical axial supporting portion 16 being provided at the center of the bottom face of the bottom portion 13; and mounting flanges 17 with mounting bores 18 being provided around the outer circumference of the case main body 12, for example, in a radial direction at intervals of 180 degrees.

On the bottom face of the bottom portion 13, a circumferential groove 13a corresponding to arc-like through-bores 37 described hereinafter is provided on a concentric circle centering on the center of the axial supporting portion 16 as an air movement passage.

Also, on the upper side of the cylindrical wall portion 14, a circling thin-walled projecting cylinder portion 14a whose inner circumferential face is the extended face of the inner circumferential face of the cylindrical wall portion 14 is provided.

Incidentally, the reference numeral 15 represents a housed portion being formed inside the case main body 12, and the housed portion is a part wherein the silicon oil 21 is housed and represents a lower part from the thin-walled projecting cylinder portion 14a.

[0010]

The rotor 31 is constituted by: a cylindrical axial portion 32; and a tabular resistive portion 36 which is continuously provided in the axial portion 32 and circular in plan view.

A cylindrical cavity 33 wherein the axial supporting portion 16 of the case 11 engages to be able to rotate is provided on the bottom surface of the axial portion 32. I-cut step portions 34 which are cut in an I-shape are provided in a part projecting

from the cap 51, and fitting grooves 35 are provided in flat surface parts (vertical surfaces) which are cut in the I-shape in a horizontal direction, respectively.

Also, as shown in Figs. 2-4, in the resistive portion 36, multiple arc-like through-bores 37 are provided on a concentric circle centering on the center of the axial portion 32 as the air retention portion. At the same time, depressed grooves 38 communicating with the arc-like through-bores 37 are provided on a concentric circle of the arc-like through-bores 37 as the air movement passage.

Incidentally, the depressed grooves 38 are provided above and below (both sides) of the resistive portion 36.

[0011]

The through-bore 52 wherein the axial portion 32 of the rotor 31 penetrates is provided at the center of the cap 51. A diameter-expansion step portion 53 which is cylindrically cut out in such a way of reaching to the lower end and houses the O-ring 61 is provided on the lower side of the through-bore 52. Moreover, a circling fitting depressed groove 55 wherein the thin-walled projecting cylinder portion 14a of the case main body 12 fits is provided on the outer edge of the lower side.

Also, an I-cut mounting bore 72 is provided at the center of the driven gear 71, and fitting projections 73 fitting into the fitting grooves 35 being provided in the axial portion 32 of the rotor 31 are provided in the flat surface parts of the mounting bore 72.

[0012]

Next, an example of assembling of the rotary damper D will be explained.

First, after the axial portion 32 of the rotor 31 is fitted into the O-ring 61 and the silicon oil 21 is applied to the cavity 33 and the resistive portion 36, one part of the axial portion 32 and the resistive portion 36 are housed inside the housed portion 15 in such a way that the axial supporting portion 16 of the case 11 is fitted into the cavity 33.

After an appropriate amount of the silicon oil 21 is injected into the housed portion 15, the thin-walled projecting cylinder portion 14a is fitted into the fitting depressed groove 55 of the cap 51 while the axial portion 32 is inserted into the through-bore 52, and an opening of the case 11 is blocked by the cap 51.

[0013]

Herewith, when the opening of the case 11 is blocked by the cap 51, air A inside the thin-walled projecting cylinder portion 14a is mostly discharged out of the case 11, and the thin-walled projecting cylinder portion 14a and the cap 51 are attached. At the same time, the O-ring 61 is housed inside the diameter-expansion step portion 53, so that the O-ring 61 prevents the silicon oil 21 from leaking between the axial portion 32 and the cap 51.

Next, the thin-walled projecting cylinder portion 14a and the cap 51 are welded and sealed, for example, in such a way of circling with high frequency welding.

When the axial portion 32 projecting from the cap 51 is pressed into the mounting bore 72 of the driven gear 71, the fitting projections 73 are fitted into the fitting grooves 35 so that the assembling of the rotary damper D is completed.

[0014]

Next, operation will be explained.

First, as shown in a solid line arrow in Fig. 3, when the rotor 31 rotates clockwise viewed from above, the resistive portion 36 rotates clockwise inside the silicon oil 21, and viscosity resistance and shear resistance of the silicon oil 21 affect the resistive portion 36. As a result, the rotation of the rotor 31 is damped.

Therefore, the rotation or movement of the gear wherein the driven gear 71 being attached to the rotor 31 engages, rack and so on is damped and slowed down.

Herewith, when the rotor 31 rotates clockwise, a negative pressure portion is generated in lower ends of the depressed grooves 38 so that the air A being mixed into the case 11 during the assembling follows the negative pressure portion and moves as shown in the solid line.

[0015]

As shown in a dotted line arrow in Fig. 3, when the rotor 31 rotates counterclockwise viewed from above, the resistive portion 36 rotates counterclockwise inside the silicon oil 21, and the viscosity resistance and shear resistance of the silicon oil 21 affect the resistive portion 36. As a result, the rotation of the rotor 31 is damped.

Therefore, the rotation or movement of the gear wherein the driven gear 71 being attached to the rotor 31 engages, the rack and so on is damped and slowed down.

When the rotor 31 rotates counterclockwise as described above, the air A shown in solid line in Fig. 3 heads toward the negative pressure portion being generated in the lower ends of the depressed

grooves 38, so that the air A moves to a position shown in a doted line in Fig. 3 passing clockwise through the circumferential groove 13a and the depressed grooves 38, and moves following the negative pressure portion.

[0016]

Herewith, the air A which moves from one arc-like through-bore 37 to the other arc-like through-bore 37 moves from one arc-like through-bore 37 to the other arc-like through-bore 37, passing through the circumferential groove 13a and the depressed grooves 38 in a state of being almost not compressed.

[0017]

As described above, according to the first embodiment of the invention, in the resistive portion 36, the multiple arc-like through-bores 37 are provided on a concentric circle, and the depressed grooves 38 connecting the arc-like through-bores 37 are provided. As a result, during the assembly, the air A being mixed into the housing can be moved from one arc-like through-bore 37 to the other arc-like through-bore 37 in a state of not being excessively compressed.

Therefore, even if the rotor 31 rotates bi-directionally, the noise being caused by the air A being mixed into the housing can be prevented.

Moreover, since the circumferential groove 13a is provided in the case 11, during the assembly, the air A being mixed into the housing can be moved from one arc-like through-bore 37 to the other arc-like through-bore 37 in a state of not being additionally compressed so that the noise being caused by the air A being mixed into the housing can be additionally prevented.

[0018]

Fig. 5 is a cross-sectional view of the rotor constituting the rotary damper of the second embodiment of the invention; Fig. 6 is a plan view of the rotor shown in Fig. 5; Fig. 7 is a bottom plan view of the rotor shown in Fig. 5; and the explanation is omitted by using the same symbols for the same parts or corresponding parts of Figs. 1-4.

[0019]

In the figures, the plastic rotor 31 is constituted by: the axial portion 32 being housed inside the case 11 and whose one part projects to the outside from the case 11; and a tabular resistive portion 36A with a circle shape in plan view which is provided in the axial portion 32 and moves through the silicon oil 21 inside the case 11.

The resistive portion 36A is constituted by: a thin-walled circular disc portion 39, for example, whose 90-degree divided four circular notches 40 are provided on the outer circumferential edge as the air retention portions; and circular arc projections 41 being provided on the outer circumferential edge of the thin-walled circular disc portion 39.

[0020]

Incidentally, as shown in Figs. 5-7, the circular arc projections 41 are provided above and below (both sides) of the thin-walled circular disc portion 39.

An inner circular depressed portion 42 which is surrounded with the circular arc projections 41 forms the air movement passage connecting the notches 40.

Also, intervals of the circumferential direction of the circular arc projections 41 are narrower than the greatest width (diameter) of the circumferential direction of the notches 40. Right-and-left ends of the circumferential direction of the notches 40 have the positional relationship of overlapping with the circular arc projections 41 in the circumferential direction.

[0021]

Next, since the assembly of the rotary damper D is the same as the first embodiment, the explanation is omitted and the operation will be explained.

First, as shown in a solid line arrow in Fig. 6, when the rotor 31 rotates clockwise viewed from above, the resistive portion 36A rotates clockwise inside the silicon oil 21, and the viscosity resistance and shear resistance of the silicon oil 21 affect the resistive portion 36A. As a result, the rotation of the rotor 31 is damped.

Therefore, the rotation or movement of the gear wherein the driven gear 71 being attached to the rotor 31 engages, the rack and so on is damped and slowed down.

When the rotor 31 rotates clockwise as described above, the negative pressure portion is generated in upper ends of the notches 40 so that the air A being mixed into the case 11 during the assembling follows the negative pressure portion and moves as shown in solid line.

[0022]

As shown in a dotted line arrow in Fig. 6, when the rotor 31 rotates counterclockwise viewed from above, the resistive portion 36A rotates clockwise inside the silicon oil 21, and the

viscosity resistance and shear resistance of the silicon oil 21 affect the resistive portion 36A. As a result, the rotation of the rotor 31 is damped.

Therefore, the rotation or movement of the gear wherein the driven gear 71 being attached to the rotor 31 engages, the rack and so on is damped and slowed down.

When the rotor 31 rotates counterclockwise as described above, the air A shown in solid line in Fig. 6 heads toward the negative pressure portion being generated in the upper ends of the notches 40, so that the air A moves to a position shown with a doted line in Fig. 6 passing clockwise through the circular depressed portion 42, and moves following the negative pressure portion.

[0023]

Herewith, the air A which moves from one notch 40 to the other notch 40 passes through the circular depressed portion 42 in a state of being almost not compressed, and moves from one notch 40 to the other notch 40.

Even if the air A heading toward the other notch 40 out of one notch 40 is centrifuged, the circular arc projections 41 lead the air A so that the air A is reliably moved to the other notch 40 from one notch 40 through the circular depressed portion 42.

[0024]

As described above, the second embodiment of the invention can achieve the same effect as the first embodiment.

[0025]

Fig. 8 is an exploded perspective view of the rotary damper of the third embodiment of the invention, and the explanation is

omitted by using the same symbols for the same parts or corresponding parts of Figs. 1-7.

[0026]

In Fig. 8, the plastic rotor 31 is constituted by: the axial portion 32 being housed in the case 11 and whose one part projects from the case 11 to the outside; and a tabular resistive portion 36B with the circle shape in plan view which is provided in the axial portion 32 and moves through the silicon oil 21 inside the case 11.

The multiple arc-like through-bores 37 are provided on a concentric circle centering on the center of the axial portion 32 in the resistive portion 36B as the air retention portion.

Also, a circumferential groove 54 is provided on the lower side face of the cap 51, corresponding to the arc-like through-bores 37, on a concentric circle centering on the center of the through-bore 52 as the air movement passage.

[0027]

Incidentally, since the assembly and operation of the rotary damper D are the same as those of the first embodiment, explanation thereof is omitted; however, the air A which moves from one arc-like through-bore 37 to the other arc-like through-bore 37 moves from one arc-like through-bore 37 to the other arc-like through-bore 37, passing through the circumferential grooves 13a, 54 in a state of being almost not compressed.

Therefore, according to the third embodiment, the same effect with the first embodiment can be achieved.

Since the circumferential groove 13a is provided in the case 11 and the circumferential groove 54 is provided in the cap 51, the

air A being mixed into the housing during the assembly can be moved from one arc-like through-bore 37 to the other arc-like through-bore 37 in a state of being almost not compressed additionally. As a result, the noise being caused by the air A being mixed into the housing can be additionally prevented.

[0028]

Fig. 9 is a cross-sectional view of the rotary damper of the fourth embodiment of the invention; Fig. 10 is a perspective view of the rotor shown in Fig. 9; and the explanation is omitted by using the same symbols for the same parts or corresponding parts of Figs. 1-8.

[0029]

In these figures, the plastic rotor 31 is constituted by: the axial portion 32 being housed inside the case 11 and whose one part projects to the outside from the case 11; and a resistive portion 36C which is provided in the axial portion 32 and moves through the silicon oil 21 inside the case 11.

The resistive portion 36C has a circle in plan view and is constituted by: a tabular resistive-portion main body 43 which has a slightly smaller diameter than the inner diameter of the cylindrical wall portion 14 constituting the case 11; and thin-walled tabular air movement passage formative projections 44 being provided on the outer circumferential surface of the resistive-portion main body 43, for example, in a radial shape in order to form air movement passages 46 at intervals of 180 degrees.

Incidentally, an air retention portion 45 is formed outside (outer circumference) of the resistive-portion main body 43 being sandwiched in the air movement passage formative projections 44,

and the air movement passages 46 become parts of above-and-below (both sides) of the air movement passage formative projections 44.

[0030]

Next, since the assembly of the rotary damper D is the same as that of the first embodiment, the explanation is omitted and the operation will be explained.

First, as shown in a solid line arrow in Fig. 10, when the rotor 31 rotates clockwise, the resistive portion 36C rotates clockwise inside the silicon oil 21, and the viscosity resistance and shear resistance of the silicon oil 21 affect the resistive-portion main body 43. As a result, the rotation of the rotor 31 is damped.

Therefore, the rotation or movement of the gear wherein the driven gear 71 being attached to the rotor 31 engages, the rack and so on is damped and slowed down.

When the rotor 31 rotates clockwise as described above, the negative pressure portion is generated in the lower ends of the air movement passage formative projections 44, so that the air A being mixed into the housing during the assembling moves following the negative pressure portion.

[0031]

As shown in a dotted line arrow in Fig. 10, when the rotor 31 rotates counterclockwise, the resistive portion 36C rotates counterclockwise inside the silicon oil 21, and the viscosity resistance and shear resistance of the silicon oil 21 affect the resistive-portion main body 43. As a result, the rotation of the rotor 31 is damped.

Therefore, the rotation or movement of the gear wherein the driven gear 71 being attached to the rotor 31 engages, the rack and so on is damped and slowed down.

When the rotor 31 rotates counterclockwise as described above, the air A which was moving following the negative pressure portion being generated in the lower ends of the air movement passage formative projections 44 when the rotor 31 is rotating clockwise, heads toward the lower ends wherein the negative pressure portion is generated and which become the opposite side of a circumferential direction of the air movement passage formative projections 44. As a result, the air A moves passing above and below the air movement passages 46 and moves following the negative pressure portion.

[0032]

Herewith, the air A which moves from one air retention portion 45 to the other air retention portion 45 moves from one air retention portion 45 to the other air retention portion 45, passing above and below the air movement passages 46 in a state of being almost not compressed.

[0033]

As described above, the fourth embodiment of the invention can achieve the same effect as the first embodiment. At the same time, since the multiple air retention portions 45 are formed between the outer circumferential surface of the resistive portion 36C and the inner circumferential surface of the case 11 in a circumferential direction, the air A being mixed into the housing during the assembly can be reliably located in the air retention portions 45.

[0034]

In the first embodiment, an example with the circumferential groove 13a is shown; however, even if the circumferential groove 13a is not provided, the same function and effect can be achieved.

In case the circumferential groove 13a is not provided, the air retention portions (arc-like through-bores 37) and the air movement passage (depressed grooves 38) function in a similar fashion without being provided on a concentric circle.

Next, in the second embodiment, at least one of the circumferential groove 13a and the circumferential groove 54 may be provided as shown in the third embodiment.

Also, in the third embodiment, an example with the circumferential groove 13a and the circumferential groove 54 is shown; however, if at least one of the circumferential groove 13a and the circumferential groove 54 is provided, the same function and effect can be achieved.

Incidentally, the example that: the housing is constituted by the case 11 and cap 51; the housed portion 15 of the silicon oil 21 is provided in the case 11; the through-bore 52 wherein the axial portion 32 of the rotor 31 penetrates is provided in the cap 51; and the O-ring 61 prevents the silicon oil 21 from leaking between the cap 51 and the axial portion 32, is shown. However, the structure may be as follows. The housing portion of the silicon oil is provided in the cap, and the through-bore wherein the axial portion of the rotor penetrates is provided in the case, so that the O-ring prevents the silicon oil from leaking between the case and axial portion.

[0035]

Moreover, the example that: the axial supporting portion 16 is provided in the case 11; and the cavity 33 is provided in the axial portion 32, so that the rotor 31 is supported to be rotatable, is shown. However, the cavity may be provided in the case, and the axial supporting portion may be provided in the axial portion.

Also, the example that the resistive portions 36, 36A-36C are integrally molded in the axial portion 32 is shown. However, the axial portion and resistive portions may be separately molded, and, for example, rotate integrally in relation to a square shank and square hole.

The example with the silicon oil 21 for the viscous fluid is shown; however, other viscous fluid which functions in a similar fashion, for example, grease and so on may be used.

[Brief Description of the Drawings]

[0036]

[Fig. 1] is a cross-sectional view showing a first embodiment of a rotary damper of the present invention.

[Fig. 2] is a cross-sectional view of a rotor shown in Fig. 1.

[Fig. 3] is a plan view of the rotor shown in Fig. 2.

[Fig. 4] is a bottom plan view of the rotor shown in Fig. 2.

[Fig. 5] is a cross-sectional view of the rotor constituting the rotary damper of the second embodiment of the invention.

[Fig. 6] is a plan view of the rotor shown in Fig. 5.

[Fig. 7] is a bottom plan view of the rotor shown in Fig. 5.

[Fig. 8] is an exploded perspective view of the third embodiment of the rotary damper of the invention.

[Fig. 9] is a cross-sectional view of the fourth embodiment of the rotary damper of the invention.

[Fig. 10] is a perspective view of the rotor shown in Fig. 9.

[Explanation of symbols]

[0037]

D	a rotary damper
11	a case (housing)
12	a case main body
13	a bottom portion
13a	a circumferential groove (air movement passage)
14	a cylindrical wall portion
14a	a thin-walled projecting cylinder portion
15	a housed portion
16	an axial supporting portion
17	mounting flanges
18	mounting bores
21	a silicon oil (viscous fluid)
31	a rotor
32	an axial portion
33	a cavity
34	I-cut step portions
35	fitting grooves
36	a resistive portion
36A	a resistive portion
36B	a resistive portion
36C	a resistive portion
37	arc-like through-bores (air retention portions)
38	depressed grooves (air movement passages)
39	a thin-walled circular disc portion
40	notches (air retention portions)

41	circular arc projections
42	a circular depressed portion (air movement passage)
43	a resistive-portion main body
44	air movement passage formative projections
45	an air retention portion
46	air movement passages
51	a cap (housing)
52	a through-bore
53	a diameter-expansion step portion
54	a circumferential groove (air movement passage)
55	a fitting depressed groove
61	an O-ring (sealing member)
71	a driven gear
72	a mounting bore
73	fitting projections
A	the air

Fig. 1

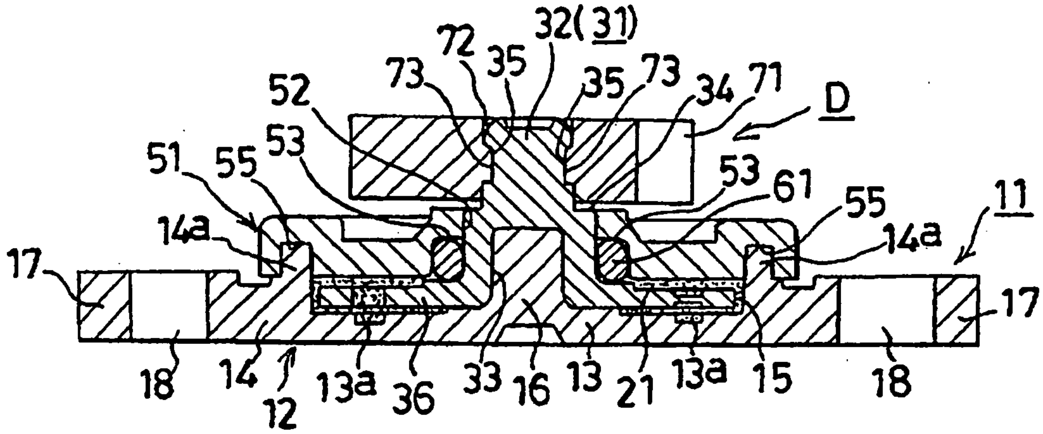


Fig. 2

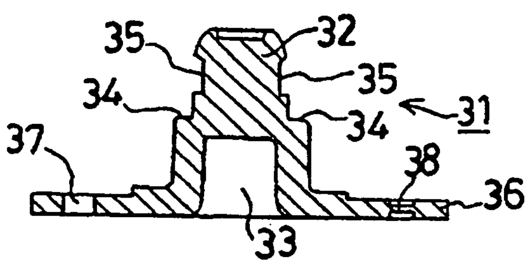


Fig. 3

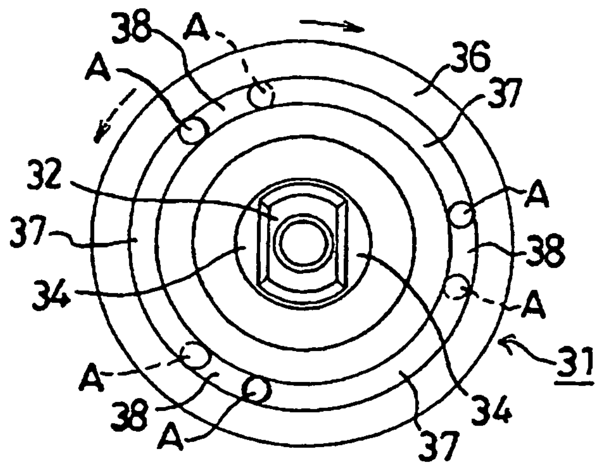


Fig. 4

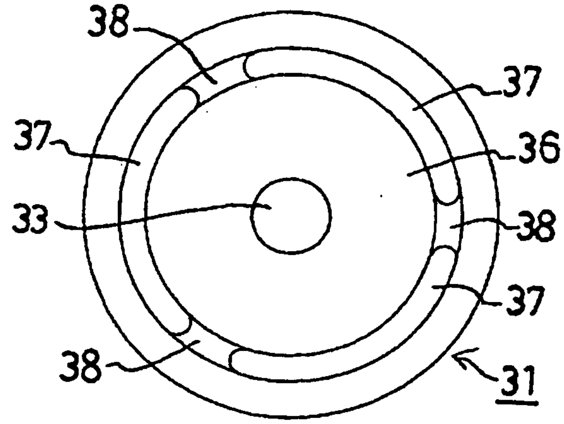


Fig. 5

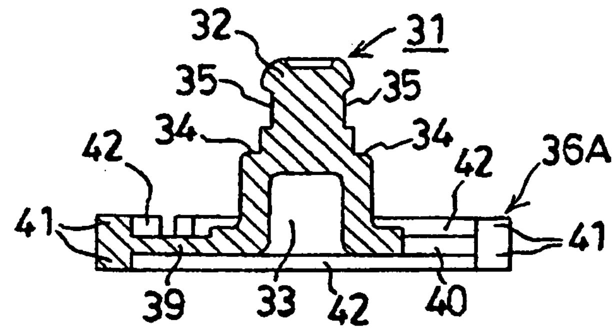


Fig. 6

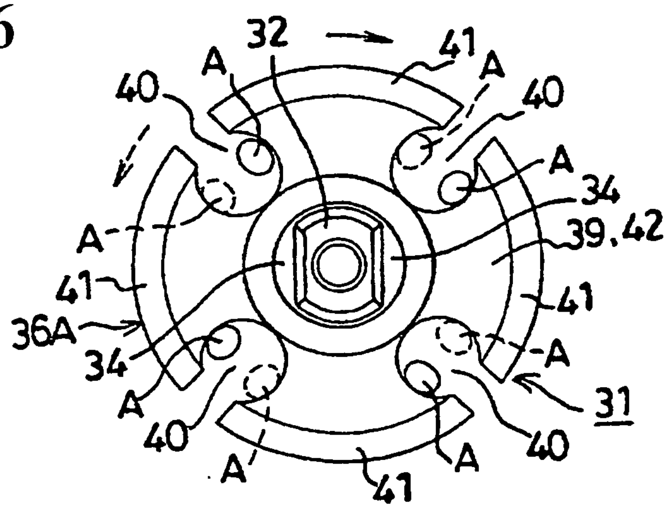


Fig. 7

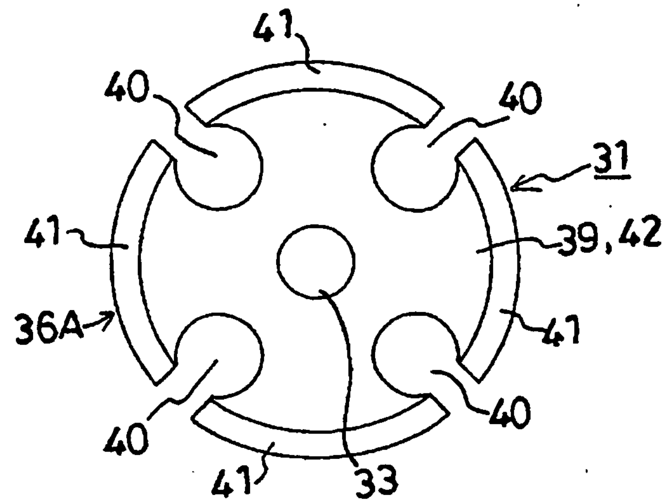

41
40
40
31
41
39, 42
36A
41
40
40
41
33

Fig. 8

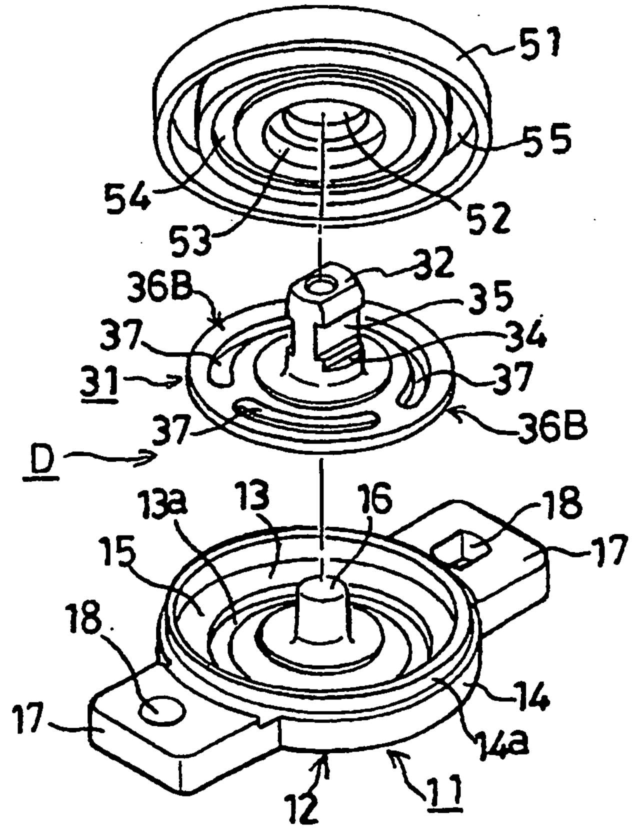
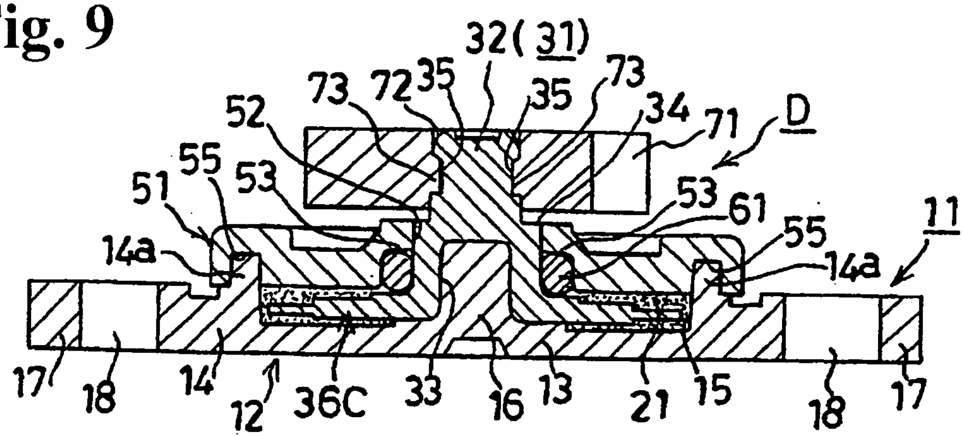

51
55
54
52
53
32
36B
35
37
34
31
37
37
36B
D
13a
13
16
18
15
17
18
14
17
14a
12
11

Fig. 9


32(31)
73
72
35
35
73
34
71
D
52
55
53
53
61
51
55
11
14a
14a
17
18
14
12
36C
33
16
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21
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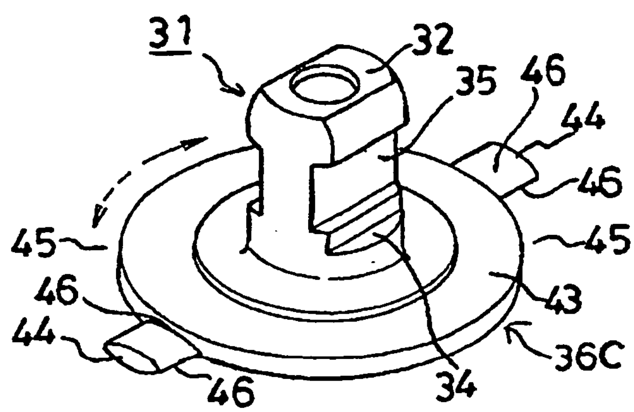
18
17

Fig. 10


31
32
35
46
44
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43
44
36C
46
34

[Name of Document] Abstract of the Disclosure

[Abstract]

[Object] A rotary damper such that during the assembly, the air being mixed into the housing is not allowed to be excessively compressed, so that even if the rotor rotates bi-directionally, the noise being caused by the air being mixed into the housing can be prevented, is provided.

[Means of Solving Problem] A rotary damper D is constituted by: housings (11, 51); a silicon oil 21 being housed inside the housings (11, 51); a rotor 31 wherein a resistive portion 36 moving through the silicon oil 21 inside the housings (11, 51) is provided in an axial portion 32 which is housed inside the housings (11, 51) and projects from the housings (11, 51); and an O-ring 61 preventing the silicon oil 21 from leaking between the axial portion 32 and the housing (51), and multiple arc-like through-bores 37 are provided in the resistive portion 36 on a concentric circle, and depressed grooves 38 communicating with the arc-like through-bores 37 are provided.

[Selected Drawing] Fig. 3